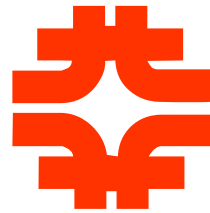


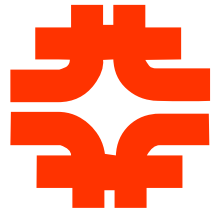
Beams Division Preparation for Run IIb



Dave McGinnis

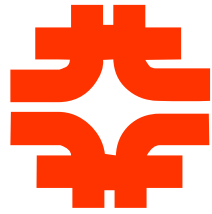
May 22, 2001

Accelerator Advisory Committee



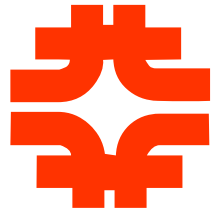
Identification/prioritization of subprojects

- 1. Slip Stacking
 - More protons on target
- 2. MI Beam loading
 - More protons on target
- 3. AP5 line
 - Better antiproton transfer efficiency
- 4. AP2 & Debuncher Aperture Upgrades
 - Better antiproton collection efficiency
- 5. Solid Lens R&D -
 - Better antiproton collection efficiency



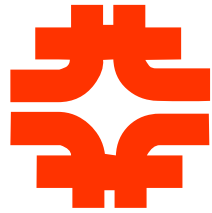
Identification/prioritization of subprojects

- 6. Accumulator Cooling
 - Better cooling
- 7. Recycler Electron Cooling
 - Better cooling
- 8. Debuncher Lattice Upgrades
 - Better antiproton collection efficiency
- 9. Linac Ion Source
 - More protons on target
- 10. TEV Tune shift compensation
 - More protons at collisions



Identification/prioritization of subprojects

- 11. Booster ramped correctors
 - More protons on target
- 12. Booster cogging
 - More protons on target
- 13. TEV. Long dampers
 - More protons at collisions
- 14. TEV Beam loading
 - More protons at collisions
- 15. Liquid Lens R&D
 - Better antiproton collection efficiency



WPAS 2002 Run 2b Project Description

- **Main Injector Slip Stacking**

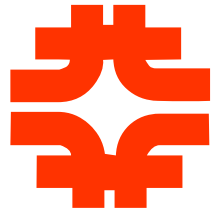
- ☐ This modification is in support of the Run IIb luminosity upgrades. This project will increase the Main Injector beam intensity for antiproton production by coalescing two Booster batches at 8 GeV.

- **Main Injector Beam Loading Compensation**

- ☐ This modification is in support of the Run IIb luminosity upgrades. Transient beam loading is expected to limit the amount of proton intensity at 8 GeV in the Main Injector. This project will install fast RF feedback in the Main Injector High Level RF that will eliminate the transient beam induced wakefields. The elimination of transient beam loading will permit higher Main Injector intensities for antiproton production

- **AP-5 Line**

- ☐ This project is in support of the Run IIB luminosity upgrades This project will be a dedicated 8 GeV beam line to transfer antiprotons from the Accumulator to the Recycler



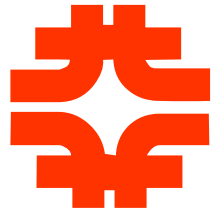
WPAS 2002 Run 2b Project Description

- **AP2 and Debuncher Aperture Increase**

- ☐ This modification is in support of the Run IIb luminosity upgrades. The AP2 acceptance and the Debuncher aperture will be increased to 40 pi mm-mrad to increase the antiproton flux in the Debuncher. This project will include mechanical aperture increases along with beam based alignment techniques. The beam based alignment will require upgrades to the present BPM system. This project should start in FY2002. However, there is not enough funding available in the current budget guidance to start this project until FY2004.

- **Solid Lithium Lens Gradient Upgrade**

- ☐ This modification is in support of the Run IIb luminosity upgrades. This project will research a number of design modifications of the current solid lithium lens that will increase the gradient of the lens.



WPAS 2002 Run 2b Project Description

● Accumulator Stack Tail Cooling

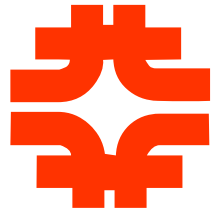
- This modification is in support of the Run IIb luminosity upgrades. An increase in the antiproton flux beyond the Run II level of 20×10^{10} antiprotons/hr requires further improvements in the stack tail cooling system. This project should start in FY2003. However, there is not enough funding available in the current budget guidance to start this project until FY2004.

● Recycler Electron Cooling

- This modification is in support of the Run IIb luminosity upgrades. Higher antiproton fluxes require better Recycler cooling. These requirements will be met with an electron cooling system.

● Debuncher Lattice Upgrades

- This modification is in support of the Run IIb luminosity upgrades. This project will research coupling, harmonic, and dispersion corrections and a gamma-t ramp to the Debuncher lattice so that the Debuncher's dynamic aperture is increased.



WPAS 2002 Run 2b Project Description

- **Linac Ion Source**

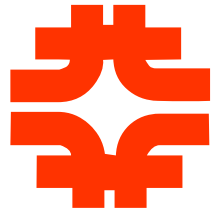
- ☐ This modification is in support of the Run IIb luminosity upgrades. The intensity of the H⁻ ion source will be increased and the emittance of the H⁻ beam will be decreased. The increase in beam brightness should permit the Booster to run with less beam loss.

- **TEVATRON Beam Beam Tune Shift Compensation**

- ☐ This modification is in support of the Run IIb luminosity upgrades. The variation in antiproton betatron tunes will be corrected with a modulated low energy electron beam.

- **Booster Ramped Correctors**

- ☐ This modification is in support of the Run IIb luminosity upgrades. The correction system in the Booster will be modified to ramp. This should permit the Booster to run with less beam loss.



WPAS 2002 Run 2b Project Description

- **Booster Cogging.**

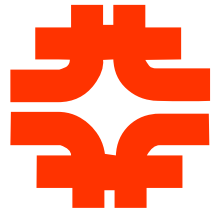
- ☐ This modification is in support of the Run IIb luminosity upgrades. This project will permit a gap to be placed in the Booster beam at 400 MeV and aligned with the Booster extraction septum at 8 GeV to minimize losses during extraction from the Booster.

- **Tevatron Longitudinal Dampers**

- ☐ This modification is in support of the Run IIb luminosity upgrades. For 132 nS bunch spacing, longitudinal instabilities are anticipated. There is not enough funding available in the current budget guidance to do this project.

- **Tevatron Beam Loading Compensation**

- ☐ This modification is in support of the Run IIb luminosity upgrades. For 132 nS bunch spacing, transient beam loading problems are anticipated. There is not enough funding available in the current budget guidance to do this project.



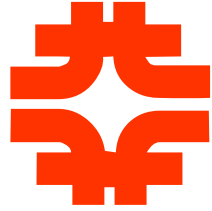
WPAS 2002 Run 2b Project Description

- **Liquid Lithium Lens**

- ☐ This modification is in support of the Run IIb luminosity upgrades. This project is based on an R&D program underway at BINP. There is not enough funding available in the current budget guidance to continue this project.

- **Linac Front End Upgrade**

- ☐ This modification is in support of the Run IIb luminosity upgrades. The Crockoft-Walton of the Proton Source will be replaced by two RFQs and the first drift tube of the Linac will be modified to reduce initial losses in the Linac. The increase in beam brightness should permit the Booster to run with less beam loss. There is not enough funding available in the current budget guidance to do this project.



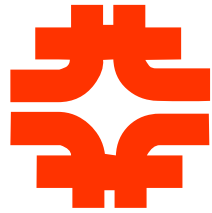
Run 2b Organization

- There is a weekly Run II B meeting with the 15 "project leaders"
 - More people can attend if they wish but those 15 should be there.
 - At each meeting there is a 20-30 min report from two of the projects.
 - We rotate through the 15 projects in 2 months.
 - Projects that have given reports to date:
 - Slip Stacking
 - Beam Loading
 - Electron Cooling
 - Solid Lens R&D
 - Debuncher Lattice Upgrade
 - AP2-Debuncher Aperture Upgrade
 - Linac Ion Source R&D



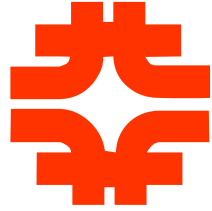
Run 2b Organization

- Each of the "project leaders" has been asked to try to assemble a team.
 - Some of the projects, the team size is one.
 - The project leaders are to organize some sort of regular meeting with their group.
 - The first task of each project is define the scope of their project.
- The Run 2b coordinator is to have a one hour meeting with each of the project leaders each week.
 - Not started because of Run 2a commissioning



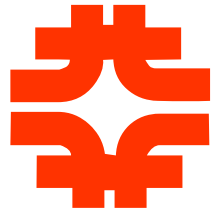
Run 2b Project Leaders

- 1. Slip Stacking - [Stemiel](#)
- 2. MI Beam loading - [Reid](#)
- 3. AP5 line - [Lebedev](#)
- 4. AP2 & Debuncher Aperture Upgrades - [Gollwitzer](#)
- 5. Solid Lens R&D - [Hurh](#)
- 6. Accumulator Cooling - [Derwent](#)
- 7. Recycler Electron Cooling - [Nagitsev](#)
- 8. Debuncher Lattice Upgrades - [Werkema](#)



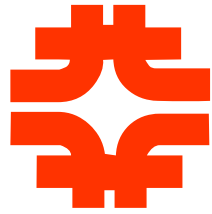
Run 2b Project Leaders

- 9. Linac Ion Source - [Dudnikov or Moehs](#)
- 10. TEV Tune shift compensation - [Shiltsev](#)
- 11. Booster ramped correctors - [Webber or designee](#)
- 12. Booster cogging - [Webber or designee](#)
- 13. TEV. Long dampers - [Tan](#)
- 14. TEV Beam loading - [Tan](#)
- 15. Liquid Lens R&D - [Leveling](#)



Run 2b Organizational Goals for CY2001

- Design Report Rough Draft for next Accelerator Advisory Committee (AAC) meeting (May 21-22, 2001)
 - Description of overall Run 2b plan will be written.
 - Rough draft will include only the scope of each Run 2b project.
- Design Report finished by October 1, 2001
 - Will include the scope, resource requirements, and schedule for each Run 2b project.
- Dedicated Run 2b project review by the AAC in December of 2001



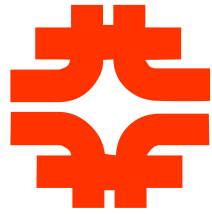
Present Technical Progress on Run 2b Projects

- Slip Stacking

- ☐ Testing of DSP algorithms in low level RF has begun
- ☐ Low intensity beam trials to start before May shutdown
- ☐ Simulations of slip-stacking without beam loading replicated
- ☐ Simulations of slip-stacking with beam loading underway.

- Beam loading

- ☐ RF feedback at fundamental operational
- ☐ Prototype RF feedback at $m=1$ lines to be tested summer 2001
- ☐ IIR design awaiting results of simulations of slip-stacking with beam loading.



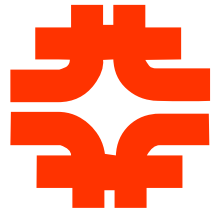
Present Technical Progress on Run 2b Projects

- AP5 line

- ☐ Reverse proton tuneup for shot setup at about 1/2 hour
- ☐ Redesign of 8 GeV AP3-AP1 lattice almost complete.
- ☐ Power supply reconfiguration of 8 GeV AP3-AP1 and 120 GeV AP1 to take place during July 2001 shutdown
- ☐ Transfer function measurements of 8 GeV P1-AP3 beam lines to begin May 2001.

- AP2 & Debuncher Aperture Upgrades

- ☐ Optics redesign has been started
- ☐ Transfer function measurements during May 2001 shutdown
- ☐ BPM system design with CDF (Ohio State) has begun
- ☐ Final installment of Debuncher Injection region improvements to be done during May 2001 shutdown



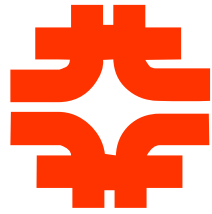
Present Technical Progress on Run 2b Projects

● Solid Lens R&D

- ☐ ANSYS mechanical and magnetic model of present lens nearly complete.
- ☐ Initial MARS tracking results using ANSYS output as input have been completed (CDF- Bussey)
- ☐ Fatigue tests of diffusion bonding underway.
- ☐ 8 cm diffusion bonded mechanical design underway. Fabrication to begin in Fall 2001
- ☐ No-beam Target Sweeping tests to begin Summer 2001

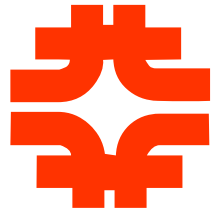
● Accumulator Cooling

- ☐ Not started



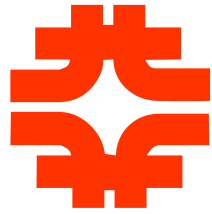
Present Technical Progress on Run 2b Projects

- Recycler Electron Cooling
 - High voltage testing of Pelletron well underway
 - Awaiting approval of SAD for electron beam re-circulation tests.
 - Construction of long beam-line mock-up well underway.
 - Preliminary civil construction design for MI-30 has been started.
- Debuncher Lattice Upgrades
 - Definition of beam studies just starting.
- Linac Ion Source
 - Not started



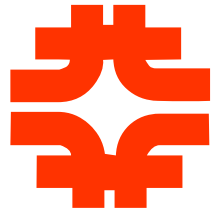
Present Technical Progress on Run 2b Projects

- TEV Tune shift compensation
 - Prototype system installed in TEVATRON
 - Tune shift of bunches observed
 - Future plans are awaiting outcome of TEV tests.
- Booster ramped correctors
 - Single sector linear electronics tested.
 - Power supply limitations require global software control.
- Booster cogging
 - First prototype successfully tested but caused large radial position excursions
 - Second prototype is built and lab tests are nearly complete. Beam tests will start before summer.



Present Technical Progress on Run 2b Projects

- TEV. Long dampers
 - Design of 36 x 36 digital under-sampled system has begun
- TEV Beam loading
 - Not started
- Liquid Lens R&D
 - Just finished second Fermilab review of BINP project.
 - 3rd lens prototype under construction with new titanium alloy.
 - Fermilab will receive liquid lithium magnetic pumping system this summer.
 - Fermilab will receive power supply this fall.



Estimated Cost of Run 2b Projects

(WPAS version)

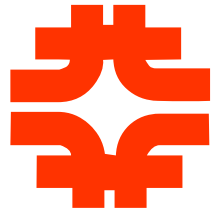
	FY01	FY02	FY03	FY04	FY05	Run IIb		Start	Operational
	Total	Total	Total	Total	Total	Total		Date	Date
PS	249	367	389	231	0	1235		Mar - FY01	Mar - FY04
Linac	149	167	139	231	0	685		Mar - FY01	Jun - FY04
Ion Source R&D	149	167	139	231	0	685		Mar - FY01	Jun - FY04
Linac RFQ	0	0	0	0	0	0		-	-
Booster	100	200	250	0	0	550		Apr - FY01	Jul - FY03
Booster Cavities	0	0	0	0	0	0		-	-
Ramped Correctors	75	100	125	0	0	300		Feb - FY01	Jul - FY03
Longitudinal Dampers	0	0	0	0	0	0		-	-
Transverse Dampers	0	0	0	0	0	0		-	-
Cogging	25	100	125	0	0	250		Oct - FY02	Jul - FY03



Estimated Cost of Run 2b Projects

(WPAS version)

	FY01	FY02	FY03	FY04	FY05	Run IIb		Start	Operational
	Total	Total	Total	Total	Total	Total		Date	Date
MI	77	693	0	0	0	770		Oct - FY02	Aug - FY02
RF	77	693	0	0	0	770		Oct - FY02	Aug - FY02
Slip Stacking	77	693	0	0	0	770		Oct - FY02	Aug - FY02
Low Level	34	306	0	0	0	340		Oct - FY02	Aug - FY02
Beam Loading Compensation	43	387	0	0	0	430		Sept - FY01	Aug - FY02
RF Power Upgrade	0	0	0	0	0	0		-	-
RR	2384	5637	5960	600	0	14580		May - FY01	Aug - FY03
Electron Cooling	2050	2700	4200	600	0	9550		Mar - FY01	Aug - FY03
AP5 line	334	2937	1760	0	0	5030		Oct - FY02	Jun - FY03
Design	110	115	125	0	0	350		Jan - FY01	Jun - FY03
Civil	211	1409	810	0	0	2430		Oct - FY02	Jun - FY03
Technical Components	13	1413	825	0	0	2250		Nov - FY02	Jun - FY03



Estimated Cost of Run 2b Projects

(WPAS version)

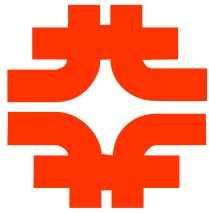
	FY01	FY02	FY03	FY04	FY05	Run IIb		Start	Operational
	Total	Total	Total	Total	Total	Total		Date	Date
Pbar	329	673	1128	5824	5987	13940		Feb - FY03	Jul - FY05
Target Station	97	291	291	1291	1000	2970		Jun - FY02	Jun - FY05
Solid Lens R&D	97	291	291	1291	1000	2970		Jun - FY02	Jun - FY05
Liquid Lens R&D	0	0	0	0	0	0		-	-
Beam Sweeping	0	0	0	0	0	0		-	-
Debuncher	197	197	197	2368	2567	5525		Jul - FY03	Jul - FY05
Aperture	197	197	197	1543	1742	3875		Sept - FY02	Jul - FY05
BPM System	62	62	62	310	224	720		Nov - FY02	Jun - FY05
Moveable Quads	135	135	135	808	538	1750		Jan - FY02	Jun - FY05
Dipole Beam Pipe	0	0	0	425	980	1405		Jan - FY04	Aug - FY05
DRF1-1	0	0	0	0	0	0		-	-
Lattice Upgrades	0	0	0	825	825	1650		Dec - FY04	Jul - FY05
Coupling Correction	0	0	0	350	350	700		Dec - FY04	Jul - FY05
Resonance Correction	0	0	0	350	350	700		Dec - FY04	Jul - FY05
Gamma - t ramp	0	0	0	75	75	150		Dec - FY04	Jul - FY05
Dispersion Correction	0	0	0	50	50	100		Dec - FY04	Jul - FY05

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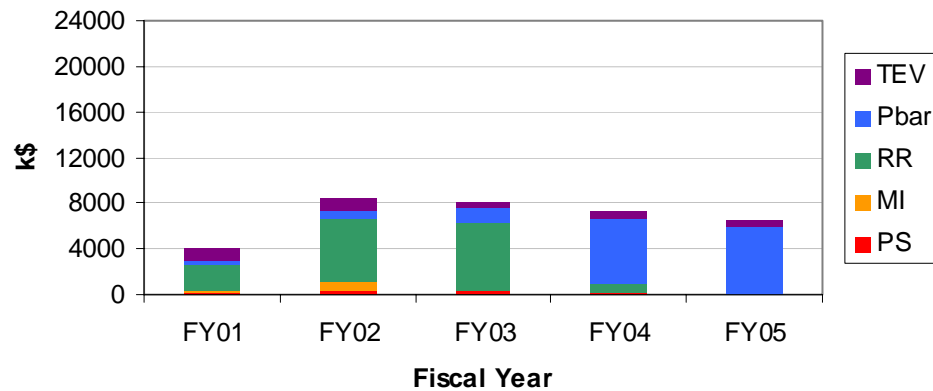
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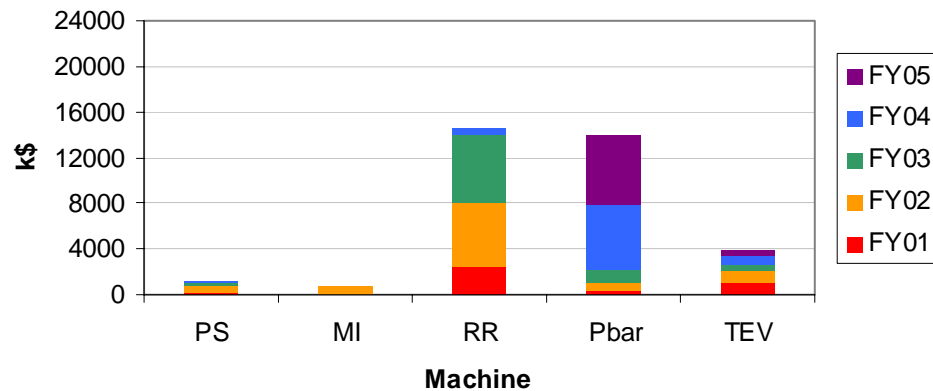
Total Cost for Run Iib

(WPAS version)

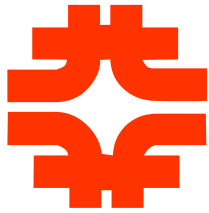
Total Cost



Total Cost



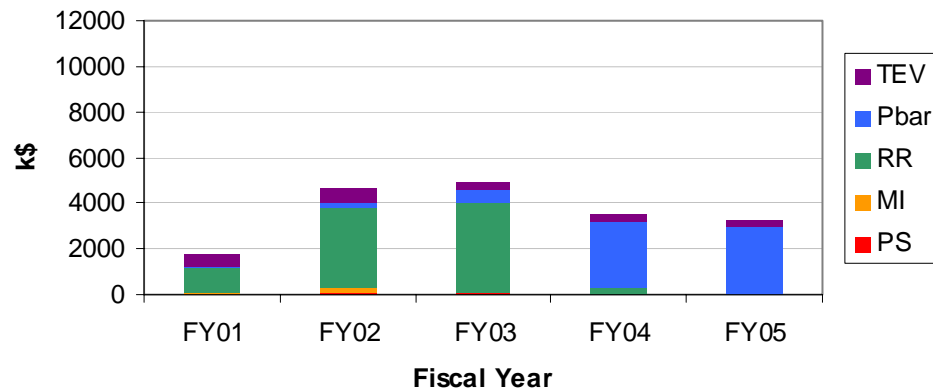
	Total					
	FY01	FY02	FY03	FY04	FY05	Total
PS	249	367	389	231	0	1235
MI	77	693	0	0	0	770
RR	2384	5637	5960	600	0	14580
Pbar	329	673	1128	5824	5987	13940
TEV	1000	1110	555	648	463	3775
Total	4038	8479	8032	7302	6449	34300



M & S Cost for Run IIb

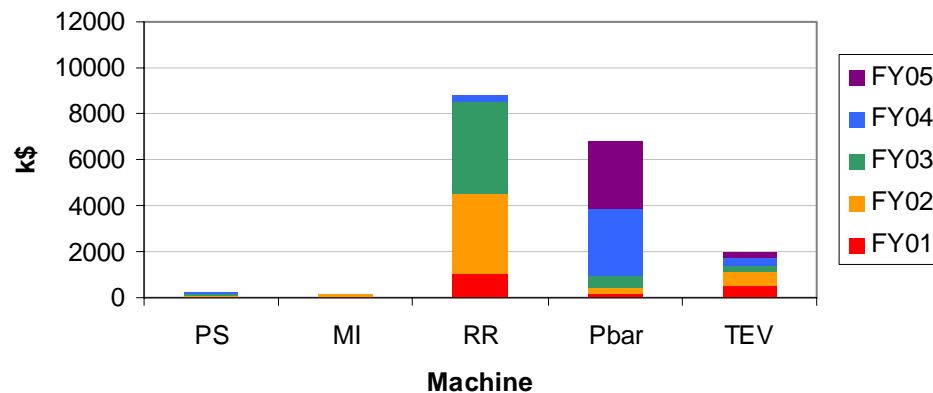
(WPAS version)

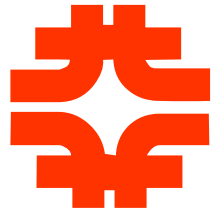
M & S



	M&S					
	FY01	FY02	FY03	FY04	FY05	Total
PS	43	67	73	38	0	220
MI	20	180	0	0	0	200
RR	1050	3500	4000	250	0	8800
Pbar	145	285	510	2890	2985	6815
TEV	500	600	300	350	250	2000
Total	1758	4632	4883	3528	3235	18035

M & S

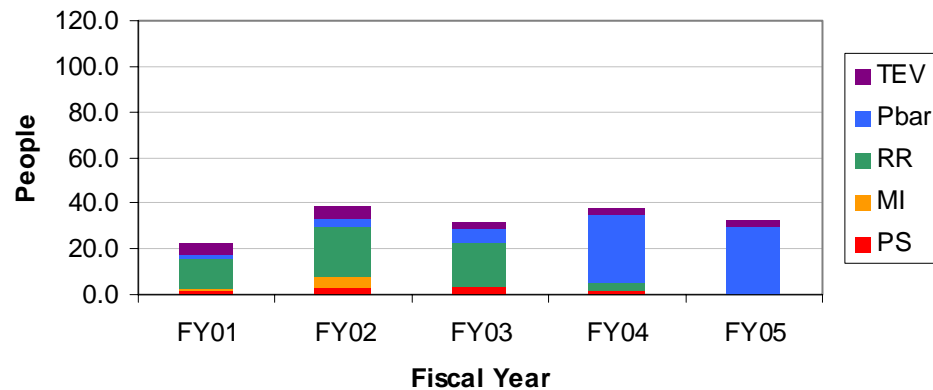




Labor Cost for Run IIb

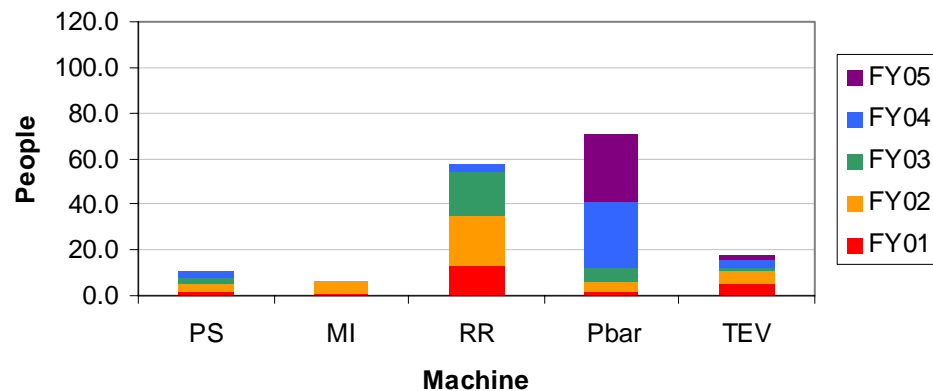
(WPAS version)

Total Labor



	Labor					
	FY01	FY02	FY03	FY04	FY05	Total
PS	2.1	3.0	3.2	1.9	0.0	10.2
MI	0.6	5.1	0.0	0.0	0.0	5.7
RR	13.3	21.4	19.6	3.5	0.0	57.8
Pbar	1.8	3.9	6.2	29.3	30.0	71.3
TEV	5.0	5.1	2.6	3.0	2.1	17.8
Total	22.8	38.5	31.5	37.7	32.1	162.7

Total Labor



	Labor\$					
	FY01	FY02	FY03	FY04	FY05	Total
PS	206	300	316	194	0	1015
MI	57	513	0	0	0	570
RR	1334	2137	1960	350	0	5780
Pbar	184	388	618	2934	3002	7125
TEV	500	510	255	298	213	1775
Total	2280	3847	3149	3775	3214	16265

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	Y 1	Y 2	Y 3	Y 4	Y 5
	O N D J F M A M J J A S	O N D J F M A M J J A S	O N D J F M A M J J A S	O N D J F M A M J J A S	O N D J F M A M J J A S
RR					
Electron Cooling					
AP5 line					
Design					
Civil					
Technical Components					
Pbar					
Target Station					
Solid Lens R&D					
Liquid Lens R&D					
Beam Sweeping					
Debuncher					
Aperture					
BPM System					
Moveable Quads					
Dipole Beam Pipe					
DRF1-1					
Lattice Upgrades					
Coupling Correction					
Resonance Correction					
Gamma - t ramp					
Dispersion Correction					



	Y 1	Y 2	Y 3	Y 4	Y 5
	O N D J F M A M J J A S	O N D J F M A M J J A S	O N D J F M A M J J A S	O N D J F M A M J J A S	O N D J F M A M J J A S
Accumulator					
StackTail Betatron Cooling					
Core Tranverse Cooling					
StackTail Pickups					
Beam Lines					
Beam Position System					
AP2 line					
Aperture					
Left Bends					
Correctors					
Chromatic Correction					
AP1 Line					
EPB dipole replacements					
F17 Cmagnet Replacements					
TEV					
Beam-Beam Tune Shift Comp					
Beam Loading Compensation					
Longitudinal Dampers					



	Y 1	Y 2	Y 3	Y 4	Y 5
	O N D J F M A M J J A S	O N D J F M A M J J A S	O N D J F M A M J J A S	O N D J F M A M J J A S	O N D J F M A M J J A S
RR					
Electron Cooling					
AP5 line					
Design					
Civil					
Technical Components					
Pbar					
Target Station					
Solid Lens R&D					
Liquid Lens R&D					
Beam Sweeping					
Debuncher					
Aperture					
BPM System					
Moveable Quads					
Dipole Beam Pipe					
DRF1-1					
Lattice Upgrades					
Coupling Correction					
Resonance Correction					
Gamma - t ramp					
Dispersion Correction					

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